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THE SNOWSTORMS.

NORTH EAST ENGLAND AND EAST SCOTLAND, MARCH 11TH TO 16TH, 1888.

Several of our correspondents, besides sending accounts of the depth of snow at their own stations, sent also copies of newspapers, some of them, like the *Scotsman* and the *Newcastle Daily Chronicle*, of March 16th, containing reports of the storm filling many columns. Altogether, we think that the columns of newspaper reports, omitting all duplicate statements, would, if joined into one column, be more than 40 feet long.

As the storm seems to have been as bad as, some say even worse than, that of February 28th to March 2nd, 1886,* we have formed a *précis* of this mass of material, and proceed to state the facts as concisely and as accurately as possible.

As to date.—The Newcastle reports say that the storm should really be regarded as having begun on the 11th, because although the earlier falls of snow had in the towns disappeared by the 14th, much was still lying on the high lands.

Blocks on the railways.—These were very serious; they began earliest in the North. The only one North of Aberdeen, and but a slight one, was to the train (on the Turriff and Macduff line in Aberdeenshire) going North from Inveramsay, which on leaving Rothie Station at 8.40 a.m., ran into a drift so deep that the train had to be backed, and the wreath charged twice before it could get through. This, however, as we have stated, was the only block in the North of Scotland, and although not quite the earliest, we mention it first so as to finish with that district.

The first block, in order of time (and, we believe, the only one on the line where one most expects a block—the Highland line) took place at its southern extremity near Stanley Junction, about 10 miles N. of Perth, at 6 a.m., on the 15th. It will, however, save time and space to give the list in tabular form. It must be understood that this list is not perfect, but merely as nearly so as we

* See *Met. Mag.*, Vol. XXI. (1886), p. 17.

can make it—*e.g.*, there are many blocks recorded for which the time is not given, so that this must not be regarded as a complete list of the blocks:—

	Designation of train.	When and where blocked.
	Perth to Blair Athol .....6 a.m.	N. of Stanley Junctn., Perthshire.
(1)	Dundee to Anstruther .....6.5 a.m.	Kingsbarns, Fifeshire.
	Anstruther to Edinburgh ...6.40 a.m.	St. Monans, Fifeshire.
(2)	Markinch to Leslie .....8.30 a.m.	Leslie, Fifeshire.
	Dundee to Perth .....9.15 a.m.	Longforgan, Perth.
	Longniddry to Haddington..9.30 a.m.	Longniddry, Haddington.
	Drem to N. Berwick ... .10 a.m.	Dirleton, Haddington.
(3)	Blairgowrie to Dundee .....10.20 a.m.	near Dundee, Forfar.
	Montrose to Bervie .....Noon	North Water, Kincardine.
	Stirling to Crieff .....Noon	Tullibardine, Perth.
(4)	Berwick to Newcastle.....1.50 p.m.	Smeafield, Northumberland.
(5)	Newcastle to Berwick.....4.40 p.m.	Longhirst, Northumberland.
(6)	Morpeth to Newcastle .....5 p.m.	Seghill, Northumberland.
(7)	Newcastle to Berwick.....5.5 p.m.	Smeafield, Northumberland.
(8)	Blyth to Newcastle.....5.15 p.m.	Backworth, Northumberland.
	Alnwick to Morpeth .....5.42 p.m.	Acklington, Northumberland.
	Blyth to Newcastle.....6.50 p.m.	Hartley, Northumberland.
(9)	Sunderland to Hartlepool ...7 p.m.	Seaton, Durham.
	Alnwick to Coldstream .....8.45 p.m.	Mindrum, Northumberland.
(10)	Sunderland to Hartlepool ...10 p.m.,	Murton, Durham.

(1). This is the same train, so probably the block at Kingsbarns was cut.

(2). Ran into a snow wreath, and in backing to charge at it again, some carriages went off the rails.

(3). Blocked near Lochee just outside Dundee, was eventually pulled through by three engines, but the snow was up to the carriage windows.

(4). This was the first English train blocked; it was a slow train coming south from Berwick, and it stuck at Smeafield, which is about two miles north of Belford.

(5). This was a goods train going north, and as it stuck at Longhirst, near Morpeth, it blocked the down line, other trains gradually accumulating behind it. In the efforts at night to get it out, a curious accident occurred. A snow plough was sent to the rescue on the other line of rails; it found the train, and then passed on so as to get on to the down rails and come back and so clear a path for the imbedded train to proceed; but what with the difficulty of seeing in the darkness and snow, and what with their brakes not acting in consequence of the snow, they drove into the stationary train and lifted its front engine on to the top of the plough, thus making matters worse than before.

(6). This is the same train as (8), so that the block cannot have been serious.

(7). This was the 4.35 p.m. express from Berwick; it was shunted to the down line so as to pass the train No. (4), but it also, though drawn by four engines, stuck fast, and about 40 passengers had to pass the night in the train.

(10). This train was sent on the down line so as to pass the one No. (9) which had stuck at Seaton at 7 p.m.; it did so, picking up the passengers from it, but they were no better off, for it itself stuck fast at, or near the next station.

From the above table it will be seen that, with the exception of the block on the Bervie branch N. of Montrose, there was a tolerably steady progression southwards in the localities blocked. For example, the mean time of first block for each county was—Fife, 7.5 a.m.; Perth, 9.5 a.m.; Haddington, 9.45 a.m.; Forfar, 10.20 a.m.; Kincardine, noon; Northumberland, 5.40 p.m; Durham, 8.30 p.m.

Area.—We have laid down, on a map, every block recorded, and from this it appears that (excepting the little one in Aberdeenshire already mentioned) all were on the East of Scotland or the North-east of England—in fact, so closely do they follow the coast line that (except one near Bowes, in North Yorkshire, where the line is nearly 1,400 ft. above the level of the sea) we do not find a single block thirty miles inland. It is, therefore, useless to give a map for a sinuous line, following the coast at about thirty miles inland, and running out to sea a few miles north of Montrose for the northern limit, and at the mouth of the Tees for the southern limit, would include the area of every important stoppage.

Duration.—The fall of snow ceased on the 16th, and on the 18th every railway line was re-opened, so that altogether it did not last a week, but near Berwick some roads became blocked on 14th, and were not clear until 22nd.

Blocked trains.—We have no idea of the total number, but there were said to be 24 on the Newcastle and Berwick line alone.

Isolated towns.—Some towns were absolutely unapproachable, either by train or road, such as, for instance, Kinross, although served by three lines of railway; but generally one road remained passable when others were blocked. Rothbury, Northumberland, is said to have been snowed up for five days.

Telegraphs.—These suffered very slightly, considering the heaviness of the storm. Perhaps they are now put up more strongly than in past years.

Depth of snow and size of drifts.—The true depth of snow when it falls during a hard gale is impossible to determine; taking the newspaper records in groups, they give 9 inches for Forfarshire, Fife, and Kinross, 12 inches for the south-eastern counties of Scotland, and 16 inches for Northumberland and Durham. As regards drifts, we may quote a few details. At Markinch, in Fifeshire, where it took 45 men eight hours of daylight to get out one engine. The Longhirst drift on the main line of the N.E. railway was said to be 12 ft. deep and two miles long, and to have had 700 men employed in clearing it. In March, 1886, the N.E. Railway Company are said to have paid £2,500 for labour alone, and the impression appears to

have prevailed in the district that the outlay for the same purpose will have been greater this year. However, they may be consoled by remembering that no lives were lost, and that this is only the second time in 30 years that their line has been blocked for 24 hours.

Previous storms.—We have already referred to our own account of the 1886 storm; we close this article with a short extract from the *Newcastle Daily Chronicle*:—

1636.—What may be considered one of the longest frosts on record in this part of the country is that which began in the middle of September, 1636, and continued until the following April—seven months in all. The modes of locomotion at the time were of the most primitive kind, and the long-continued frost is stated to have been attended by disastrous consequences to man and beast. The cattle of the hills and folds succumbed in hundreds to the severity of the weather, and their unfortunate proprietors were subjected to a financial loss, from the effects of which many of them never recovered. In addition, the necessities of the people were for a lengthened period anything but fully met.

It is somewhat strange, however, in reviewing the effects of winter severity to find, that the old-fashioned winters of which some people speak so glibly, have been succeeded by others that have taken place at a totally different period of the season. The old storms, like the long frost recorded above, began generally about October or November, and continued during the remainder of the year. In recent years the winters have been open and generally fine until after Christmas, and nearly all the great storms that have taken place in the North of England during the present century have been witnessed in the first, second, or third months of the year.

1814.—On January 14th, a hard frost was experienced on Tyneside. The Tyne, from St. Peter's upwards, was completely frozen over, and the people of Newcastle held high carnival upon the ice. Tents, according to the local historian, were erected upon it, fires lighted, and donkey races and other sports held.

1823.—What is described by the chroniclers of the day as being a dreadful snowstorm was raging in the North of England on February 4th, 1823. The local roads, such as they were, became entirely blocked, and communication between villages, hamlets, and large towns was thoroughly cut off. Stage coaches and mail coaches were then the conveyances most familiar to the public, and at the Turf Hotel, Collingwood Street, and at one or two other old hostelries in Newcastle, exciting scenes were witnessed. Travellers who had come to the town a day or two before were compelled to remain, and what was perhaps of more importance to the public, both inside and outside of Newcastle, all postal communication was, for the time being, brought to an end. For a whole week, the north and west mail coaches neither reached nor were despatched from Newcastle, and it was only when on one day thirteen saddle horses with messengers were despatched northwards that communication with the outer world was again established.

1854 (?).—About 34 years ago, for a few days, a similar scene was witnessed, for the Tyne down to St. Lawrence was firmly ice-bound, tents were pitched, vendors of all sorts of commodities did a thriving trade, and hundreds of per-

sons disported themselves upon the ice. At that time the only weak parts in the glassy sheet were near the Quay edge, and keelmen and steamboatmen—who were, for the time being, idle—took advantage of that circumstance, and by making bridges of planks over their craft, and by levying toll, they turned to profitable account the inclemency of the weather. There are yet in the land of the living many persons who will recollect not only the stirring pastimes of the pleasure-seekers, but the exciting work performed by the steamers afterwards employed to break up the ice as the thaw began. These vessels were strengthened at the stem for the work, and as they slowly moved up the river and cut their way through the resisting barrier of ice, hundreds of towns-people assembled on the quays and bridges to witness the work going on. That work was, however, but slowly performed, and it was a long time before full traffic on the river could be resumed.

1886.—The great snowstorm which began on the 1st of March, two years ago, and continued for two days, must be well remembered. There had never been so serious a downfall of snow witnessed by this generation. The blocks that ensued on the local railways were a serious impediment to traffic, costing the companies thousands of pounds, and involving many persons in a great sacrifice of time and money. Many were the adventures of the imprisoned passengers on the railways, and the recollection of the incident down the north line in which the prssengers were driven to great straits for food will be recalled with grim humour by some who played a part in that conspicuous incident of the storm. For the first time, probably, since 1823, the villages lying to the north and west of Newcastle were effectually cut off from communication with the town. The expense thrown upon local boards and other authorities was very great. In some instances hundreds of men had to be emplcyed in clearing a way through the snow, and the enormous and lofty snow cuttings made in the Kenton, Ponteland, and Dudley portions of the district will probably never be forgotten by those who saw them. Postal and telegraphic communication was interrupted for many miles, milk from the country—to the very serious loss of the dairymen—could not be brought into the town, and on the hills of Allendale, and in the neighbourhood of Rothbury, hundreds of sheep were lost.

ON THE CONTINENT.

Nor must it be supposed that the British Isles alone have suffered in this way. Here is one illustration :—On Sunday night, March 25th, a Paris correspondent said that a thousand soldiers and navvies succeeded in freeing the trains which were in distress near Chartres, about 40 miles S.W. of Paris, but owing to fresh falls of snow the railway was still blocked up. Traffic was interrupted between Compiègne and Clermont, about 50 miles N. of Paris. There were two feet of snow in the streets of Montpelier, only seven miles from the Mediterranean, and the roads leading to Avignon were snowed up. In Spain some of the railways were blocked for a week.

SNOW AND ROSES.

We may also mention with advantage a short note which appeared recently in the *Globe*, in which it is stated that the question of pre-

venting railways being drifted up has been much discussed in Austria and Hungary, and that—

A rose-hedge is now said to be the most effective defence. More than a mile of one of the Hungarian railways has been this winter kept clear of drifts by a rose-hedge about 6½ feet high and 3¼ feet thick, although this section of the line had always in previous years been liable to be blocked. The rose best adapted for this purpose is the rose of Provins, now incorrectly corrupted into the rose of Provence. But doubtless there are many other kinds equally serviceable: the essential thing is that the hedge shall offer a solid obstacle to the drifting snow. It will be a great improvement, certainly—apart from all practical considerations—if we could be induced to make our lines of railway blossom with the rose. At present, the banks which border our lines are neither useful nor ornamental. Here and there a little kitchen garden flourishes, or a fowl-keeping station-master cultivates sunflowers for his birds. But there is no serious attempt either to grow cabbages or cabbage roses along the lines. In Brittany the lines run between small fruit-gardens, with innumerable pear and apple trees trained espalier fashion at the sides; and the practical cultivation of fruit-trees is adopted along the high roads in Germany. We might take a leaf out of our neighbours' books either in the useful or ornamental direction.

"BLIZZARD" IN NEW YORK, MARCH 12th.

In our number for February last we gave, as a sort of explanation of the newspaper accounts of the terrible damage in Dakota and other States, a definition of what Americans know as a blizzard.

Since that was written there has appeared in the *Leisure Hour* for April a descriptive account of the disaster, by Miss Gordon Cumming, which we can strongly recommend to the notice of our readers.

New York has also had such a snowstorm as it appears hardly ever to have had before, and if not a perfect blizzard, quite sufficiently near it to satisfy the most *exigeant* New Yorker. Our impression is that it was not a perfect blizzard, *i.e.*, that it did not fulfil conditions (1) and (2) on p. 3 of this Magazine.

The following telegram gives as good a general idea of the storm as the fuller accounts which have since been received:—

A "BLIZZARD" IN NEW YORK.

NEW YORK, MARCH 12.

This city lies helpless to-day in the grip of a genuine Western "blizzard." It began at midnight, and when the city awoke the streets were filled with huge banks of snow. The wind was blowing a gale; the air was so thick with snow that it was impossible to see for any distance. When people ventured into the streets the wind took away their breath. The snow blinded their eyes, and progress was almost a physical impossibility. Not a train, car, or omnibus was able to run. The elevated railroad attempted to run, but by eight o'clock was completely blocked. The trains were standing in lines, miles long, filled with impatient merchants, bankers, and brokers, striving to get to town to business. It was difficult to realise for some time that a great

city could be made so helpless. Passengers got into the cars for three or four hours, hoping to be able to proceed. The wind blew so hard that it shook the railway carriages, and caused the whole structure to tremble. Long after the hope of getting on had gone, the passengers hesitated to leave the cars, because the blinding snow made the task of reaching home not only difficult, but dangerous. They ventured out by twos and threes, ploughing their way through drifts which stood from five to ten feet deep along the Fifth Avenue, Broadway, and all the great thoroughfares to the nearest hotels and club houses. When they reached them their hair and beards were masses of ice and snow, making them look like visitors from the Arctic regions. Here and there cabs were seen, with horses covered with sleet and the drivers almost blinded with the snow, struggling to make headway. Only a few people succeeded in reaching their business places. About twenty men were at the Stock Exchange at the hour of opening, and the Exchange adjourned, deliveries to be made to-morrow. None of the other Exchanges transacted business. The banks were not opened, and at the time I send this off it looks as if no evening papers would be published, as the editors and compositors are unable to reach the offices. All the trains from the outside districts are blockaded, as the storm extends over a wide area, and it is thought that many other cities are in the same condition as New York.

LATER.

During the afternoon the weather became warmer, but the wind continued high, and the air was still thick with snow. The elevated railroad was able to run a few trains at long intervals, but the tramways are entirely suspended. Very few shops are open in any part of the city, and business of all kinds is suspended. Some of the evening papers have managed to get out editions, but the delivery of them throughout the city is practically impossible. No such storm has been seen here for many years.

THE DENSITY OF SNOW.

Everybody seems to be talking of, and writing about, snow this winter (to say *winter* on April 4th, but it has been snowing again to-day), and M. Lancaster, of Brussels, has so good an article in the last number of our excellent contemporary, *Ciel et Terre*, that we must say a few words about it; but only a few, as our readers should read the whole article, which occupies ten pages. The paper is divided into two parts—the first historical, the second analyzing the observations made at the Monastery on the Great St. Bernard during the 20 years, 1862–81.

M. Lancaster traces back measures of the yield of snow to Sédileau, who, in 1692, found snow to be five or six times less dense than water, and then he quotes De la Hire (1711) 12 to 1, Mairan (1749) 10 to 1, Musschenbrook (1751) from 19 to 1 down to 5·6 to 1, but on the average 10 to 1. He then quotes values from nearly every country in Europe (except Russia, where they ought to know most about it), and reports fully the very careful observations made by Colonel Ward at Rossinière, in Switzerland. The broad result is to

confirm the results arrived at by British investigators, namely, that snow may in very rare cases be so light that 35 inches may be required to produce 1 inch of water; or so dense that 5 inches will be sufficient; and that the general average is between 14 to 1 and 9 to 1.

In the second section, M. Lancaster shows that the St. Bernard observations give about $9\frac{1}{2}$ to 1, but that the value varies according to the season, being 12 to 1 in winter and 5 to 1 in summer. He then takes the observations for the three years, 1878–80, and groups the mean snow ratios according to the mean temperature of each day. His table converted into English scale gives the following values :—

Density.	Temperature.	Difference.	Density.	Temperature.	Difference.
6 : 1	35°·6		10 : 1	26°·6	
		—1°·8			—1°·8
7 : 1	33 ·8		11 : 1	24 ·8	
		—1 ·8			—3 ·6
8 : 1	32 ·0		12 : 1	21 ·2	
		—2 ·7			—5 ·4
9 : 1	29 ·3		13 : 1	15 ·8	
		—2 ·7			—7 ·2
			14 : 1	8 ·6	

It will be seen that the density of snow decreases with lower temperature, but as the difference is a decreasing one, there is perhaps some other cause besides the temperature. One would like to know *exactly* the method adopted by the monks in making the observations. Moreover it is not improbable that at that great altitude (8,173 ft.) the general character of the snow differs from that at stations within a few hundred feet of the level of the sea.

ROYAL METEOROLOGICAL SOCIETY.

The usual monthly meeting of this Society was held on Wednesday evening, March 21st, at the Institution of Civil Engineers, Great George Street, Westminster; Dr. W. Marcet, F.R.S., President, in the chair.

Dr. G. E. Scholefield and Col. W. S. Young were elected Fellows of the Society.

The President (Dr. Marcet) delivered an address on "Atmospheric Electricity." He first mentioned the experiments by Franklin in America in 1752, who succeeded in obtaining the electricity of a storm-cloud by conducting it along the string of a kite sent into the cloud. De Romas in Europe repeated the experiment, and having placed a wire within the twine his kite was attached to, obtained sparks of nine or ten feet in length. The characters of the two kinds of electricities were next described : the vitreous, or positive, which was produced by rubbing glass, and the resinous or negative, obtained by rubbing sealing wax or other resinous substance ; and it was shown by bringing

suspended balls of pith within the influence of these electricities, that electricities of different kinds attract each other, and those of the same kind repel each other. De Saussure's and Volta's electroscopes were next described, pith balls being used in the former, and blades of straw in the latter, for testing the electricity. With the object of measuring the force of electricity, Sir W. Thomson's electrometer was mentioned, in which the electricity is collected from the air by means of an insulated cistern letting out water drop by drop, each drop becoming covered with electricity from the atmosphere, which runs into the cistern where it is stored up, and made to act upon that portion of the instrument which records its degree or amount. The atmosphere is always more or less electrical, or in other words, possessed of electrical tension, and this is generally positive; while the earth exhibits electrical characters of a negative kind. The effects of atmospheric electricity were classed by Dr. Marcet under three heads :—1st. Lightning in thunderstorms; 2nd. The formation of hail; 3rd. The formation of the Aurora Borealis and Australis. Dr. Marcet next proceeded to show a representation of a flash of lightning, which he produced by throwing on a white screen the image of an electric spark two or three inches in length, enlarged by means of the lens of an optical lantern to six or eight feet in length. After alluding to the protecting power of lightning conductors and their construction, Dr. Marcet explained the formation of hail and of waterspouts, and exhibited an instrument by Prof. Colladon, of Geneva, for showing the formation of waterspouts. He concluded his address with a few remarks on the Aurora Borealis and Australis, the formation of which was illustrated by De la Rive's experiment, which consisted of successive discharges of electric sparks through a partial vacuum while under the influence of a powerful magnet; sheets of electric light were seen assuming the form of bands, and possessed of a certain rotating motion.

Mr. G. J. Symons, F.R.S., read a short communication entitled "The Non-existence of Thunderbolts; elucidated by accounts of searches after them and the exhibition of specimens of things supposed to be thunderbolts."

In connection with this meeting, a very interesting exhibition of instruments was arranged in the rooms of the Institution of Civil Engineers. The exhibition was devoted chiefly to instruments connected with atmospheric electricity. There were various forms of electrometers, including those formerly in use at the Greenwich and Kew Observatories. Numerous patterns of lightning conductors were exhibited, together with models of churches, houses, chimney-shafts, and ships, showing the various methods of protection. The Postal Telegraph Department showed a number of lightning protectors used for telegraph purposes. Many objects damaged by lightning were exhibited, including lightning conductors, telegraph apparatus, portions of rafters, trees, &c., also the clothes of a man

torn off his body by lightning. An interesting collection of meteorites, and some alleged thunderbolts were shown, the latter being of very various origin. There were also several new meteorological instruments exhibited, which had been brought out during the past twelve months.

One of the special features of the exhibition was a valuable and interesting collection of more than fifty photographs of lightning flashes. Many of these were taken during the great thunderstorm which occurred in London on August 17th last year, others had been taken in various parts of the world.

The exhibition included also a large number of photographs of damage by lightning, and photographs of clouds and meteorological instruments, as well as records of atmospheric electricity, &c.

THE EFFECT OF SNOW ON THE SPRINGS.

To the Editor of the Meteorological Magazine.

SIR,—A recent correspondence in the *Times* has raised the question of the comparative value of snow and rain in supplying the springs, and it has been asserted confidently that snow is more efficacious for that purpose than an equivalent quantity of rain. I venture to express an opinion that the reverse of this statement would be nearer the truth, although I doubt the wisdom of laying down any general law upon a matter in which so much must depend on the circumstances of each case and upon the precise terms of the comparison.

If the snow has been preceded by a long and severe frost, and has fallen with a low temperature, when a thaw comes, the surface of the ground will probably remain for some days impervious to moisture, and meanwhile more or less of the product of the melting snow will find its way directly into the streams and rivers. On the other hand, if the snow has not been preceded by any considerable frost, and especially if it has commenced with rain, when the thaw comes, the ground, being scarcely if at all frozen, will readily absorb the water.

In either case the rate of the thaw will greatly influence the result. With a rapid thaw, a quantity of the water must inevitably be lost. With a very slow thaw, even when the ground has been frozen to some depth, time will be given for the ice within it to melt, and the bulk of the water may be saved for the soil and the springs.

It has been stated that the loss by evaporation will be less with snow than with rain. I believe this to be an error. Rain in winter is generally accompanied with a very moist air, in which evaporation is almost *nil*. A deep snow, on the contrary, not unfrequently marks the commencement of a period in which the air is particularly dry and evaporation very active. Moreover, rain, sinking at once into

the soil, is removed from the influence of evaporation, while snow may present an evaporating surface during several weeks. In this matter observation confirms what theory suggests. A striking instance came under my notice in the deep snow of February last. Some days after the fall I placed a number of circular boards, 8 inches in diameter, on the top of the snow, that I might more easily measure the depth of any subsequent fall. No further fall of any moment occurred, but after an interval which I omitted to note—it may have been a week or more—I observed that each of the boards was mounted on a tump of snow about an inch above the general surface, and shelving off to nothing at the circumference of the board. It was evident that the snow had suffered a loss of one inch in depth from some cause other than subsidence or thaw, for each of these causes would have produced at least as much effect underneath the boards as around them. There can, I think, be no doubt that an inch of snow had been lost by evaporation, which had proceeded freely over the general surface, less freely under the outer part of the board, and not at all under its central part.

I have said that in comparing snow and rain as regards their effect upon the springs, much will depend upon the precise terms of the comparison. In the case of snow, the rate of fall is of no consequence; in the case of rain, it is important. If we compare the fall of an inch of water as snow with the fall of an inch of water as rain, the fall of rain being comprised within one hour, the advantage will probably lie with the snow as a feeder of the soil and the springs. But if we suppose the fall of rain to be uniformly distributed over 24 hours, the tables will be turned. In the first case, a large quantity of the rain will be wasted; in the second case, it will be wholly absorbed.

To put the matter fairly, mention should be made of two circumstances which must tend to diminish the loss of water in the melting of snow over frozen ground. The one is, that the water from the melting of the upper strata of the snow, percolating through the lower strata, will help to thaw the ground. The other is, that a certain quantity of the water will be retained in the unmelted snow, ready to be absorbed by the soil when the soil is sufficiently thawed to receive it.

Speaking broadly, and omitting the less important details, one may say that, as regards the proportion of water saved and the proportion lost, snow and rain both follow the same law; only, in the case of snow, it is not the rate at which it *falls*, but the rate at which it *thaws*, that has to be considered.

GEORGE F. BURDER, M.D.

Clifton, 5th April, 1888.

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, SEPTEMBER, 1887.

STATIONS. (*Those in italics are South of the Equator.*)	Absolute. Maximum. Temp.	Maximum. Date.	Minimum. Temp.	Minimum. Date.	Average. Max.	Min.	Dew Point.	Humidity.	Absolute. Max. in Sun.	Min. on Grass.	TotalRain. Depth.	Days.	Aver. Cloud.
	°		°		°	°	°	0–100	°	°	inches		0-10
England, London	69·5	6	34·3	29	62·8	47·9	46·5	74	118·6	31·4	1·81	19	6·1
Malta.....	93·4	10	65·7	24	86·8	71·1	67·0	69	148·6	61·0	·28	4	2·5
Cape of Good Hope ...	90·0	4	40·2	22	73·8	48·8	...	...	...	...	·88	4	4·7
Mauritius.....	77·4	28	55·1	9	74·7	63·4	58·5	71	129·0	44·0	·86	10	5·2
Calcutta.....	91·3	9	76·6	24	87·3	78·3	76·9	80	153·6	72·8	9·54	21	8·0
Bombay.....	86·7	8	73·4	22	83·2	75·5	73·9	83	149·2	69·4	18·23	19	7·3
Ceylon, Colombo	87·0	27*a*	72·8	1	85·2	75·7	69·6	73	145·5	69·5	·48	6	6·0
Melbourne.....	73·1	18	35·2	20	59·3	44·2	43·5	74	125·5	29·0	2·71	19	6·0
Adelaide	79·2	30	40·5	25	63·3	46·3	44·8	70	136·9	31·7	2·52	21	5·0
Wellington	...	...	...	...	...	...	...	...	...	...	...	...	...
Auckland	63·0	25	40·0	15	59·2	47·6	45·9	75	122·0	35·0	4·18	19	7·0
Falkland Isles.....	49·1	25	23·2	21	40·2	31·5	32·3	86	118·9	21·4	1·49	21	8·3
Jamaica, Kingston.....	93·1	9	69·6	4	90·4	72·4	72·8	74	...	...	3·32	...	...
Barbados	86·0	23*b*	71·0	18*c*	84·0	73·0	...	80	...	...	7·77	15	5·0
Toronto	79·1	13	35·1	24	65·8	47·2	48·1	71	...	29·4	1·17	9	5·6
New Brunswick, Fredericton	76·1	6	31·0	26	64·4	43·7	48·0	76	...	...	1·41	7	5·2
Manitoba, Winnipeg ...	83·8	19	23 2	23	67·3	40·5	44·8	71	...	...	1·77	12	4·3
British Columbia, Victoria	78·0	6	30·0	21	64·8	43·5	...	...	...	...	1·16	5	...

a And 29. *b* And 24. *c* And 19.

REMARKS, SEPTEMBER, 1887.

MALTA.—Mean temp. 78°·0. Mean hourly velocity of wind 8·0 miles. Sea temp. fell from 81°·9 to 78°·5. TS on 27th. J. SCOLES.

Cape of Good Hope.—The driest September but one (1865) since 1840. W. ELLERTON FRY.

Mauritius.—Mean temp. of air 1°·0, of dew point 1°·0, and rainfall ·76 in. below average. Mean pressure 30·198 in., equal to average. Mean hourly velocity of wind 11·4 miles, 0·8 mile below average; extremes 25·8 miles on 11th, and 1·6 miles on 29th; prevailing direction S.E. by E. to E.S.E. C. MELDRUM, F.R.S.

COLOMBO.—Rainfall 4·19 in. below the average. F. C. H. CLARKE, LT.-COL. R.A.

Melbourne.—Mean temp. of air 1°·5 and mean pressure and mean amount of cloud slightly below average. Rainfall ·42 in. and mean temp. of dew point and mean humidity slightly above average. Prevailing winds W. and N.; strong on 8 days, with heavy squalls on 6 days. Dense fog on 14th; H and sleet on 7th, L on 1st and 18th, T on 11th; heavy dew on 4 days. R. L. J. ELLERY, F.R.S.

Adelaide.—Unusually cold and squally. Mean temp. 2°·3 below the average of 30 years. Mean pressure 30·025 in., ·043 in. below average. Rainfall ·72 in. above average. Gales on 10 days. C. TODD.

AUCKLAND.—A showery, squally, and unsettled month. Rainfall ·75 in. above the average of 20 years; mean temp. 1° 2 and pressure ·24 in. below average. T. F. CHEESEMAN.

Falkland Isles.—The coldest and worst September on record. Mean temp. 3°·4 below the average of 9 years and 1°·2 below that of 1886, the coldest of those years; frost on ground on 23 nights. F. E. COBB.

KINGSTON.—Earthquake on 23rd at 6.45 a.m. MAXWELL HALL.

BARBADOS.—Pressure steady, but a sudden fall occurred on 28th, followed next day by a fall of 2·13 in. of R in 3 hours. Mean temp. (77°·6) 0°·9 above average; mean hourly velocity of wind 1·7 miles, and rainfall considerably below average. R. BOWIE WALCOTT.

SUPPLEMENTARY TABLE OF RAINFALL, MARCH, 1888.

[For the Counties, Latitudes, and Longitudes of most of these Stations, see *Met. Mag.*, Vol. XIV., pp. 10 & 11.]

Div.	STATION.	Total Rain.	Div.	STATION.	Total Rain.
		in.			in.
II.	Dorking, Abinger	4·17	XI.	Castle Malgwyn	4·02
,,	Margate, Birchington...	3·20	,,	Rhayader, Nantgwillt..	6·49
,,	Littlehampton	3·64	,,	Carno, Tybrith	3·71
,,	Hailsham	4·48	,,	Corwen, Rhug	2·08
,,	Ryde, Thornbrough	4·11	,,	Port Madoc	2·67
,,	Alton, Ashdell.....	4·35	,,	I. of Man, Douglas	3·41
III.	Oxford, Magdalen Col...	2·98	XII.	Stoneykirk, Ardwell Ho.	2·06
,,	Banbury, Bloxham	2·84	,,	New Galloway, Glenlee	2·85
,,	Northampton	2·66	,,	Melrose, Abbey Gate...	3·62
,,	Cambridge, Beech Ho...	2·33	XIII.	N. Esk Res. [Penicuick]	4·90
,,	Wisbech, Bank House..	2·52	XIV.	Ballantrae, Glendrishaig	1·77
IV.	Southend	1·84	,,	Glasgow, Queen's Park.	2·88
,,	Harlow, Sheering	3·21	XV.	Islay, Gruinart School..	3·11
,,	Rendlesham Hall	4·05	XVI.	St. Andrews, Pilmour Cot	3·13
,,	Diss	3·42	,,	Balquhidder, Stronvar..	4·62
,,	Swaffham	2·38	,,	Dunkeld, Inver Braan..	4·57
V.	Salisbury, Alderbury...	3·41	,,	Dalnaspidal H.R.S. ...	4·32
,,	Warminster	3·57	XVII.	Keith H.R.S.	2·93
,,	Bishop's Cannings	3·60	,,	Forres H.R.S.	3·39
,,	Ashburton, Holne Vic....	9·49	XVIII.	Strome Ferry H.R.S....	4·23
,,	Hatherleigh, Winsford.	5·34	,,	Fearn, Lower Pitkerrie.	2·36
,,	Lynmouth, Glenthorne.	4·84	,,	Loch Shiel, Glenaladale	6·73
,,	Probus, Lamellyn	4·21	,,	S. Uist. Ardkenneth ...	...
,,	Launceston, S. Petherwin	5·19	,,	Invergarry	4·63
,,	Wincanton, Stowell Rec.	3·26	XIX.	Lairg H.R.S.	2·01
,,	Taunton, Lydeard Ho...	3·92	,,	Forsinard H.R.S.	2·36
,,	Wells, Westbury.....	3·11	,,	Watten H.R.S.	1·89
VI.	Bristol, Clifton	3·54	XX.	Dunmanway, Coolkelure	4 69
,,	Ross	3·84	,,	Fermoy, Gas Works ...	2 42
,,	Wem, Clive Vicarage ...	2·08	,,	Tipperary, Henry Street	2·86
,,	Cheadle, The Heath Ho.	2·86	,,	Limerick, Kilcornan ...	2·68
,,	Worcester, Diglis Lock	2·61	,,	Miltown Malbay.....	3·47
,,	Coventry, Coundon	2·53	XXI.	Gorey, Courtown House	2·66
VII.	Melton, Coston	2·51	,,	Navan, Balrath	4·14
,,	Ketton Hall [Stamford]	2·70	,,	Mullingar, Belvedere...	4·11
,,	Horncastle, Bucknall...	2·43	,,	Athlone, Twyford	3·69
,,	Mansfield, St. John's St.	2·84	,,	Longford, Currygrane...	3·80
VIII.	Knutsford, Heathside ...	1·94	XXII.	Galway, Queen's Coll...	2·94
,,	Walton-on-the-Hill... .	2·39	,,	Clifden, Kylemore	5·66
,,	Lancaster, South Road.	3.25	,,	Crossmolina, Enniscoe..	5·42
,,	Broughton-in-Furness ..	4·24	,,	Collooney, Markree Obs.	3·74
IX.	Shipley, Esholt Vic. ..	4·04	XXIII.	Rockcorry.....	3·63
,,	Ripon, Mickley	4·89	,,	Warrenpoint	2·83
,,	Scarborough, West Bank	2·91	,,	Seaforde	4·64
,,	East Layton [Darlington]	4·23	,,	Belfast, New Barnsley .	4·39
,,	Middleton, Mickleton ..	2·40	,,	Cushendun	3·31
X.	Haltwhistle, Unthank..	3·53	,,	Bushmills	2·99
,,	Shap, Copy Hill	4·68	,,	Stewartstown	3·40
XI.	Llanfrechfa Grange	4·89	,,	Buncrana	3·43
,,	Llandovery	4·99	,,		

MARCH, 1888.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average. 1870–9	Greatest Fall in 24 hours. Dpth	Date.	Days on which ·01 or more fell.	TEMPERATURE. Max. Deg.	Date	Min. Deg	Date.	No. of Nights below 32°. In shade.	On grass.
			inches	inches.	in.								
I.	ENGLAND.	London (Camden Square) ...	3·34	+ 1·73	·39	13	20	54·5	10	24·7	2	14	22
II.		Maidstone (Hunton Court)...	3·01	+ 1·43	·42	10	22	...	...	...	...	...	...
,,		Strathfield Turgiss	3·41	+ 2·01	·36	26	21	60·5	8	19·6	2	16	24
III.		Hitchin	2·86	+ 1·38	·51	11	20	57·0	10	23·0	1	20	...
,,		Winslow (Addington)	2·99	+ 1·23	·35	10*a*	19	57·0	10	13·0	2	20	24
IV.		Bury St. Edmunds (Culford)	3·07	+ 1·51	·80	12	15	52 0	10	18·0	2	24	...
,,		Norwich (Cossey)	2·27	+ ·58	·46	11	16	...	...	...	...	...	...
V.		Weymouth(LangtonHerring)	3·01	...	·45	10	17	52·0	10*b*	23·0	1	15	...
,,		Barnstaple.....	3·80	+ 1·31	·60	24	20	55·0	9, 10	22·0	2	...	...
,,		Bodmin	4·89	+ 1·73	·79	10	20	54·0	10	20·0	2	18	19
VI.		Stroud (Upfield)	3·70	+ 1·89	·48	8	22	56·0	10	21·0	1	...	...
,,		ChurchStretton(Woolstaston)	2·26	+ ·10	·49	11	15	52·5	10	22·5	2	22	25
,,		Tenbury (Orleton)	3·07	+ 1·20	·47	24	20	57·6	9	20·0	2	21	23
VII.		Leicester	1·87	...	·30	10	17	51·0	8, 29	24·0	2	21	...
,,		Boston	2·10	+ ·81	·40	22	14	58·0	9	25·0	5	13	...
,,		Hesley Hall [Tickhill].....	2·30	...	·40	11	16	61·0	9	26·0	24	23	...
VIII.		Manchester (Ardwick).....	1·56	— ·89	·35	9	15	54·0	9	26·0	2	19	...
IX.		Wetherby (Ribston Hall) ...	3·68	+ 1·55	·90	12	14	...	...	...	...	...	...
,,		Skipton (Arncliffe)	4·63	— ·13	1·03	11	19	52·0	9	19·0	1	19	...
,,		Hull (People's Park)	2·10	+ ·29	·47	11	21	...	...	...	...	...	...
X.		North Shields	4·69	+ 3·24	1·39	29	23	58·0	10	23·5	26	21	22
,,		Borrowdale (Seathwaite).....	9·62	— ·27	1·82	9	20	...	...	...	...	...	...
XI.	WALES.	Cardiff (Ely).....	5·02	+ 2·33	·66	8	19	...	...	...	...	...	...
,,		Haverfordwest	3·37	+ ·18	·71	12	15	53·0	9, 10	21·0	1	15	21
,,		Plinlimmon (Cwmsymlog) ...	3·44	...	·70	22	15	...	...	...	...	...	...
,,		Llandudno.....	2·11	+ ·23	·55	11	18	56·0	8	25·7	2	17	...
XII.	SCOTLAND.	Cargen [Dumfries]	2·61	— ·17	·74	14	16	52·6	10*c*	21·6	5	21	...
,,		Jedburgh (Sunnyside).....	2·06	+ ·49	·49	29	14	55·0	10	22·0	2	23	...
XIV.		Old Cumnock	3·00	+ ·07	·85	7	16	55·0	8	16·0	16	24	...
XV.		Lochgilphead (Kilmory)	4·60	— ·01	1·25	7	14	...	...	...	...	...	...
,,		Oban (Craigvarren)	3·52	...	1·13	7	13	55·8	8	23·8	17	18	...
,,		Mull (Quinish).....	3·14	...	·92	7	15	...	...	...	...	...	...
XVI.		Loch Leven Sluices	4·90	+ 2·78	·90	16	17	...	...	...	...	...	...
,,		Dundee (Eastern Necropolis)	3·35	+ 1·59	·55	28	13	51·9	7	23·6	17	21	...
XVII.		Braemar	2·78	+ ·59	·77	7	21	49·5	8	2·0	17	27	29
,,		Aberdeen	3·37	...	·54	10	21	54·0	8	17·0	28	21	...
XVIII		Lochbroom	4·71	...	1·21	7	18	...	...	...	...	...	...
,,		Culloden	2·66	+ ·91	...	...	...	54·0	9	22·0	28	19	29
XIX.		Dunrobin	3·40	...	1·05	7	15	51·0	6	25·5	21*b*	18	...
,,		Kirkwall (Swanbister)..... ..	...	...	...	...	..	...	...	...	...	...	..
XX.	IRELAND.	Cork (Blackrock).....	3·06	+ ·30	1·07	10	21	56·0	6*d*	25·0	24*e*	18	..
,,		Dromore Castle	5·51	...	1·12	10	18	...	...	...	...	...	...
,,		Waterford (Brook Lodge) ...	3·17	...	·84	10	17	54·0	10	24·0	17*f*	15	...
,,		O'Briensbridge (Ross)	3·80	...	1·26	10	18	52·0	9	26·0	2	14	...
XXI.		Carlow (Browne's Hill)	3·34	+ 1·23	·69	14	19	...	...	...	...	...	...
,,		Dublin (FitzWilliam Square)	3·75	+ 2·02	1·01	11	18	58·6	8	26·9	17	11	26
XXII.		Ballinasloe	3·09	+ ·71	·64	28	19	53·0	8	21·0	20	24	...
XXIII		Waringstown	3·43	+ 1·37	1·13	11	17	59·0	8	20·0	16*g*	20	23
,,		Londonderry (Creggan Res.).	2·96	...	·65	11	22	...	...	...	...	...	...
,,		Omagh (Edenfel)	3·01	+ ·92	·77	11	24	51·0	9	24·0	19*a*	17	25

a And 25. *b* And 28. *c* And 21. *d* And 10, 22. *e* And 26. *f* And 24, 25. *g* And 19.

+ Shows that the fall was ab the average ; —that it was below it.

METEOROLOGICAL NOTES ON MARCH, 1888.

ABBREVIATIONS.—Bar. for Barometer; Ther. for Thermometer; Max. for Maximum; Min. for Minimum; T for Thunder; L for Lightning; T S for Thunderstorm; R for Rain; H for Hail; S for Snow.

ENGLAND.

STRATHFIELD TURGISS.—A cold, wintry month, more like January than March, with a slight burst of warmth on 12th and 15th, followed by a severe paroxysm of cold and S, with E. winds. Vegetation at a standstill. The birds, puzzled by the continued cold, refuse to pair or build. Gale on 11th.

HITCHIN.—A very cold, ungenial month; such a backward season never known before. None of the spring flowers out and no spring corn sown.

ADDINGTON.—A cold, comfortless month, the max. temp. for many days in succession not rising above 36°, and with E. winds it was very cold. The R was, with one exception, the greatest in any March during 17 years. Pressure towards the end of the month was unusually low. Very little of the usual March work had been done in gardens at the close. Stormy on 10th and 11th, with a large flood on the latter day; ground white with S on 14th, 17th, 20th, 25th, and 26th, the depth on the latter day being two inches.

CULFORD.—Very cold all the month. S on seven days.

LANGTON HERRING.—R 1·24 in. above the average of 13 years; mean temp. 3°·4 below the average of 16 years, during which period March has been colder only in 1883 and 1887. Stormy on 11th and 28th. Fog on four days.

BODMIN.—A remarkably cold month. Mean temp. 38°·8.

STROUD.—A very cold, snowy month. S on six days. S.S.W. gale on 11th.

WOOLSTASTON.—Another very cold month. S fell on five days. L on 28th, and a severe storm of T and L on evening of 29th. Mean temp. 39°·5.

ORLETON.—Severe frost occurred on the first six mornings; a change of wind to the S.W. then took place, followed by very unsettled weather and a higher temp. On the 11th the wind returned to the N. and the remainder of the month was very cold, with frequent falls of S, which covered the hills till nearly the close, but was never more than six or seven inches deep. Pressure was generally low and specially so on 11th and 28th. The wind was generally cold and rough, and the mean temp. was 3°·3 below the average of 27 years, but was not so low as in 1887. Much distant L was seen in the S. after 8 p.m. on the 29th, and distant T was heard on 15th.

MANCHESTER.—A very wintry month, with S falls and cold winds; the night temp. was low and there were occasional severe frosts.

HULL.—The month was remarkable for the prevalence of slight frosts, and the frequent, though generally not heavy, falls of R, S, or sleet, with variable winds.

NORTH SHIELDS.—S on seventeen days.

SEATHWAITE.—In the three days 7th to 9th 5·25 in. of R fell.

WALES.

HAVERFORDWEST.—A very cold, inclement month, but not so cold as March, 1886 or 1887. The 1st was the most severe day of the winter, its mean temp. being 27°·5. Very stormy and wet on 11th, with bar. 28·850 in. (cor.) A very cold, frosty period set in on 12th, lasting to 20th, with bitter E. winds. It was very stormy and cold from 25th to 28th, the bar. on the latter day falling to 28·476 in. (cor.) The remainder of the month was cold, but fine.

SCOTLAND.

CARGEN.—The coldest March recorded (mean temp. 36°·7) with the exception of 1883, when the mean temp. was °·4 lower. Pressure unusually low; N. and E. winds prevailed on 21 days; vegetation very backward; sunshine 99 hours, 30 below the average. S on seven days.

OBAN.—Until the 10th disturbed weather, with moderate R prevailed;

thereafter it was fine, with temp. and pressure below the average and much dryness and a high ozone register.

DUNDEE.—Snow lay on the ground during the month, and shrubs, such as rhododendron, ligustrum, &c., suffered from frost.

ABERDEEN.—The month on the whole was wet, rough, and unseasonable. Gale, with heavy sleet showers, on 28th.

LOCHBROOM.—The month on the whole was stormy and severe; the first third was very mild, the second third was dry, with severe frost, and the last third was frosty, with S, sleet, and R almost daily.

CULLODEN.—The month was very severe, but without any heavy S; frost prevailed from the 12th to the end and labour was greatly retarded.

IRELAND.

CORK.—Cold and showery, with a few slight falls of S. The seventeenth successive month with less than the average R.

WATERFORD.—R ·21 in. above average. S on the Comeraghs on 15th; T on 29th. [The remark last month should read, "With the exception of 1887, the driest February in 30 years."]

ROSS.—Fairly good March weather; very cold about the middle, and in the latter part of the month. N. and N.E. winds prevailed. Many light showers of S.

DUBLIN.—The month was very cold, except for a brief period from the 6th to the 10th inclusive and also on 21st and 22nd. The precipitation, which was very large, was chiefly in the form of S or sleet and H, and the winds, which were high and squally, came principally from polar points of the compass. Mean temp. 39°·8, the month being the coldest March for at least a quarter of a century.

EDENFEL.—After having enjoyed an unusually dry and open winter until March 7th, the weather from that date to the end of the month was most inclement. S, sleet, R, and frost prevailed, occasionally accompanied by N. gales of much severity. All vegetation was arrested and farm labour at a standstill.

ERRATUM.

In the *Meteorological Magazine* for March, page 21, line 11 from bottom, for "western" read "*eastern.*"

THICKNESS OF CALM ATMOSPHERE.

To the Editor of the Meteorological Magazine.

SIR,—At Sydney, N.S.W., on June 7th, 1886, the smoke from the chimney of a large sugar factory, distant 4,490 feet from the Observatory, was observed to rise up in a vertical line until the top was 25° high; there a light wind bent it on one side. The Observatory stands 146 feet above the water, and it appears that the smoke rose straight up, and was not influenced by any lateral motion of the wind, or in other words, the air was quite still up to an altitude of 2,225 feet. The day was remarkably calm all through, but the great altitude to which the smoke rose surprised me, as I had never before seen it rise so high. As to weather, we were in the middle of an anti-cyclone, which lasted about a fortnight. Highest barometer 30·52 in.; on the 7th it was 30·42 in. Perhaps the above may be interesting, as it affords one good measure of the depth of calm atmosphere at Sydney. H. C. RUSSELL, F.R.S.

Sydney Observatory, 7th February, 1888.